Risk Management of Airfield Lighting Through Education

Transportation Systems 2004 Workshop

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Transportation Guidance Systems

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As a pilot -

And a certified airfield lighting specialist

I look at the final product of airfield lighting What I can see.

The following pictures were taken over the past couple of years - they show what most claim to be maintenance problems.

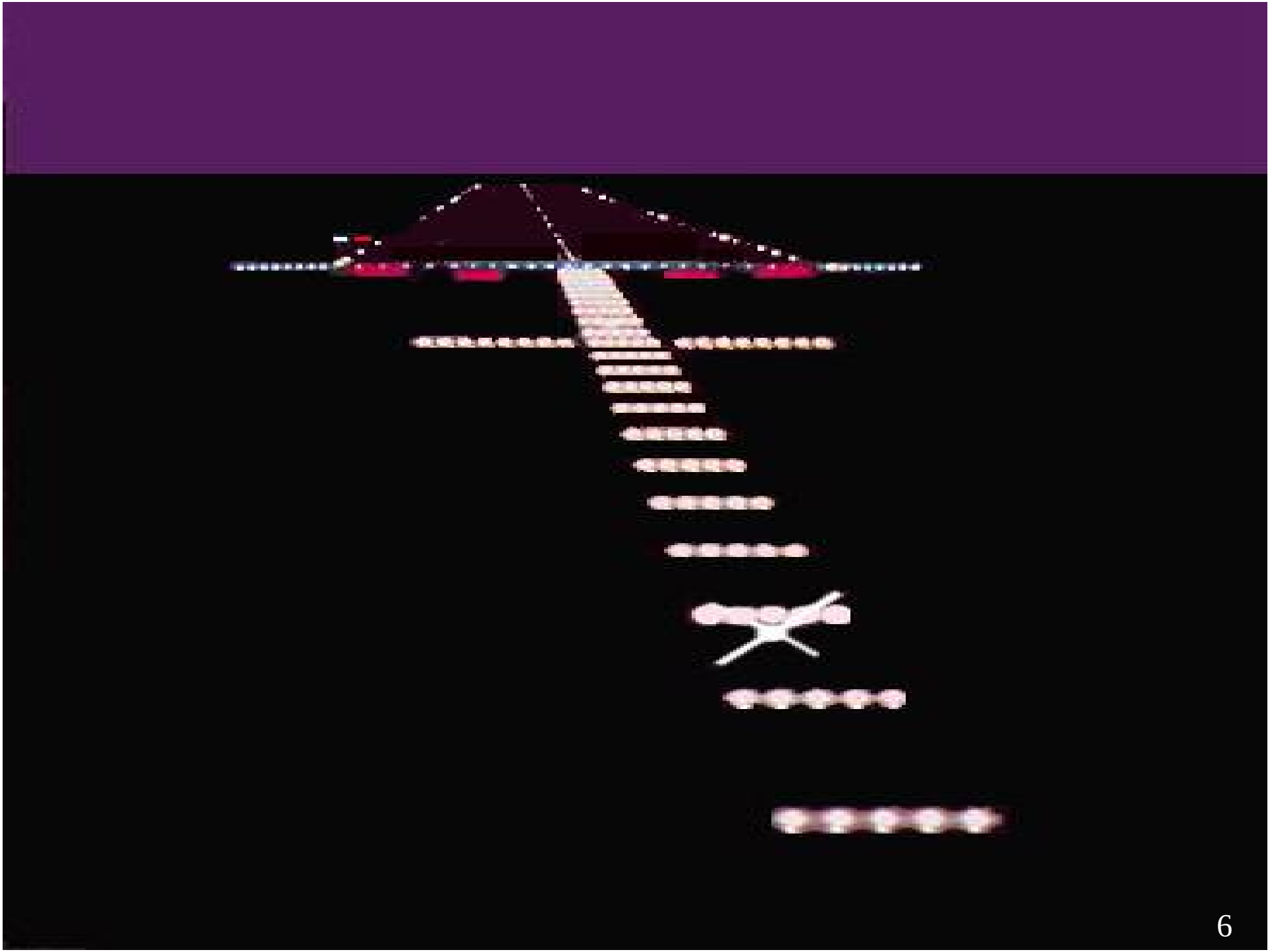
Some indeed are, but could there be something deeper?

Design & Maintenance Training Why Do *"I"* Need It?

Sounds Like More *^%@!* Work I Don't Have Time To DO!!!!

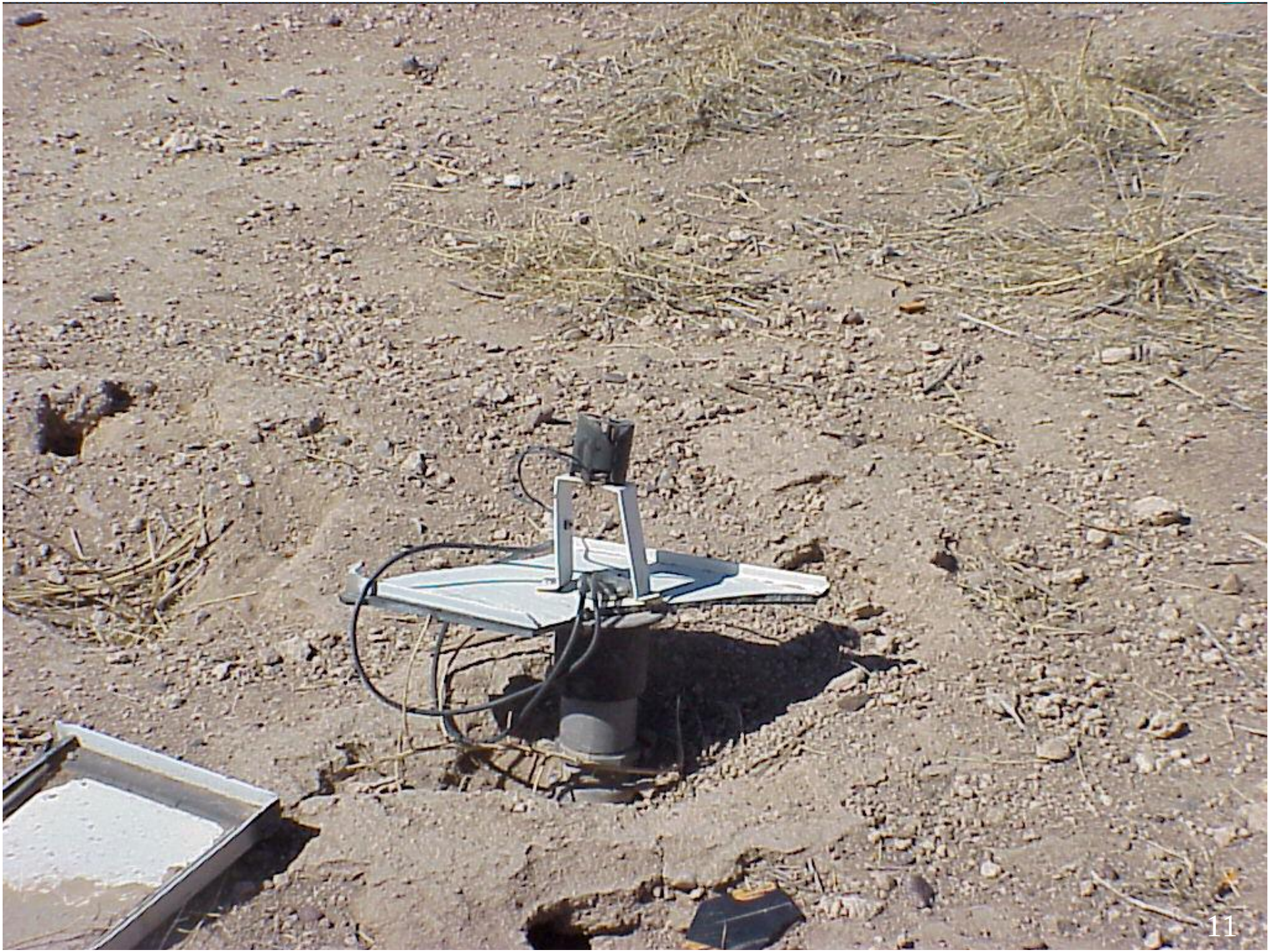
One Good Reason-

Airfield Lighting Systems have from 20 to 200 times the current and voltage necessary to KILL!!!!!!!!!!




21-3


TERMINAL
BUILDING
AND FUEL



A Few Basics

- Man / Woman is basically a Two Dimensional Animal.
  - Before flight we had both feet planted two dimensionally on the ground.
- Flight added a Third Unfamiliar Dimension.
  - Without proper instruments and visual cues man / woman looses orientation in that third dimension.
  - Man / Woman's Depth Perception is Severely Reduced in darker periods.
- Airfield Lighting Provides VISUAL CLUES to a pilot for both orientation and depth perception.

- The 5 C's of Airfield Lighting

The 5 C's (PHOTOMETRICS) What a Pilot Sees.

- Candelas
  - Intensity or brightness
- Coverage
  - Beam width, height & aiming angle
- Configuration
  - Alignment of fixtures into a recognizable pattern
- Color
  - White / Red / Blue / Green / Amber
- Consistency
  - Equal pattern, spacing, color, coverage & intensity
- EACH OF THESE ITEMS AIDS ORIENTATION & PERCEPTION

Photometrics

- ***Both the FAA & Military have always set photometric values for each type of fixture.***
  - ***Until recently Candelas & Coverage could only be checked in a laboratory.***
  - ***In the field, checking to insure fixtures were properly installed and aimed has been haphazard at best.***
  - ***In the field, intensity could only be assumed if the fixture was on or off.***
  - ***No formal Training has been required or available in the 5 C's.***
  - ***90+ % of those who design, install and maintain Airfield Lighting are not pilots and don't understand the importance of the 5 C's.***

IES

ILLUMINATING ENGINEERING SOCIETY OF NORTH AMERICA
AVIATION LIGHTING COMMITTEE

"Dedicated to the study and application of Light and Lighting to the spaces and functions involved in the operation of Aircraft"

1998 Conference

Albuquerque New Mexico
Wyndham Albuquerque Hotel
October 19-23, 1998

On- Site Photometric Testing

- Mr. Paul Fleming of the CAA in England gave a paper detailing the results of On-Site photometric testing of UK Airfields.
  - In his presentation he cited that all airfields tested in the UK **did not** meet minimum photometric requirements.
  - Reasons cited for the failures in the order of violation were -
    1. Lack of Training
    2. Lack of Maintenance.
    3. Lack of proper installation.
    4. Lack of proper design.
    5. Manufacturers sub-standard products.

Before I go Further -

- **The next few comments result from my observations of 20 years working with hundreds of airfield projects and the organizations who specify, design, install, manage and maintain airfield lighting systems.**
- **They are not intended to pick out individuals or organizations - there are exceptions.**
- **Comments are instead intended to call attention to the system itself and lack of training and certification for those who design, install and manage airfield lighting systems.**

Today's Situation

- **In the United States no training or certification is required for designers, installers or maintainers of airfield lighting systems. Other parts of the world do require training and certification.**
- **On the job training, while better than nothing, has resulted in splintered training-**
  - Specifiers train specifiers.
  - Designers train designers.
  - Installers train installers.
  - Maintenance technicians train maintenance personnel.
- **This has resulted in little or no communication between these disciplines.**
- **When I first started in airfield lighting in 1984, I thought that this lack of communication had to be the exception rather than the rule.**
- **Twenty years of my observations have proven that it is the opposite.**

Today's Situation (Continued.)

- **Designers use cut and paste with only references to standards.**
  - They do not specifically spell out tolerances necessary for proper installation leaving little teeth in the specification for installers compliance.
  - Few are aware of how this will affect what the pilot sees, and how it can affect maintenance.
- **Installers do not have copies of the Standards nor training in those standards.**
  - In the low bid process, they cut every corner possible to make the highest profit.
  - Specifications without teeth affords them more leeway to cut corners.

Today's Situation (Continued.)

- **Inspectors do not have copies of the standards nor training in those standards.**
  - With only references to standards in specifications, and no teeth in those specifications, inspectors lack ability to insure installation within Standards tolerances.
  - Most specifications do not include on-site photometric testing now available to assure compliance.
- **Maintenance personnel do not have copies of maintenance standards nor training in those standards.**
  - If their systems are not designed and installed correctly, lacking initial compliance, maintainers are behind the 8 ball from the beginning.
  - If they are not aware of preventative maintenance requirements, systems quickly go out of compliance.

Today's Situation (Continued.)

- **Managers do not have training and only a few have copies of standards.**
  - Most are not aware that airfield lighting systems begin to deteriorate the minute they are turned on, and without preventative maintenance will quickly be out of photometric compliance.
  - Managers usually feel that preventative maintenance is "advisory" and not required.
  - They are not aware the acceptance of federal money requires the systems be maintained regularly and that they must furnish proof of their ability to maintain airfield lighting.

How Did We Get Here?

- Airfield Lighting has always been an orphan.
  - Attitude if it is burning it's fine.
  - Little or no thought to Risks or proper training.
  - Standards difficult to obtain and decipher.
  - Communication between designers, installers, maintainers is almost nonexistent.
  - Funds for construction difficult to obtain.
  - Funds for maintenance last on the totem pole and not supported by federal money.
  - Confusion about "ADVISORY" standards for minimum preventative maintenance requirements.
- Newer ideas, new technology, and legal attitude make the old way "if it is burning - it's fine" very dangerous !

Airfield Lighting Design

- **Maintainable Visual Aid Systems always begin with a great design**
  - Don't simply "cut and paste" and refer only to Advisory Circulars.
  - Write in the special provisions or on the plans tolerances allowed by the MILITARY/FAA for each item.
    - Location tolerances
    - Aiming tolerances
    - Electrical tolerances
    - Pulling tolerances
    - Never allow a contractor to drag airfield lighting cable on the ground during installation!!!!! Put it in words - Cable must be spooled off during installation.
    - Use cable in conduit if at all possible.
    - Use airfield light bases if at all possible.
- **Most contractors and inspectors are not aware of specific tolerances and don't have the advisory circulars on the job -- be informative in your design and add teeth to the plans & specs by being specific.**

UFC 3-535-01
XX November 2002

US Army Corps of Engineers

UNIFIED FACILITIES CRITERIA (UFC)

DESIGN STANDARDS FOR VISUAL AIR NAVIGATION FACILITIES

U.S. ARMY CORPS OF ENGINEERS
NAVAL FACILITIES ENGINEERING COMMAND
AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

UFC 3-535-02
XX May 2002

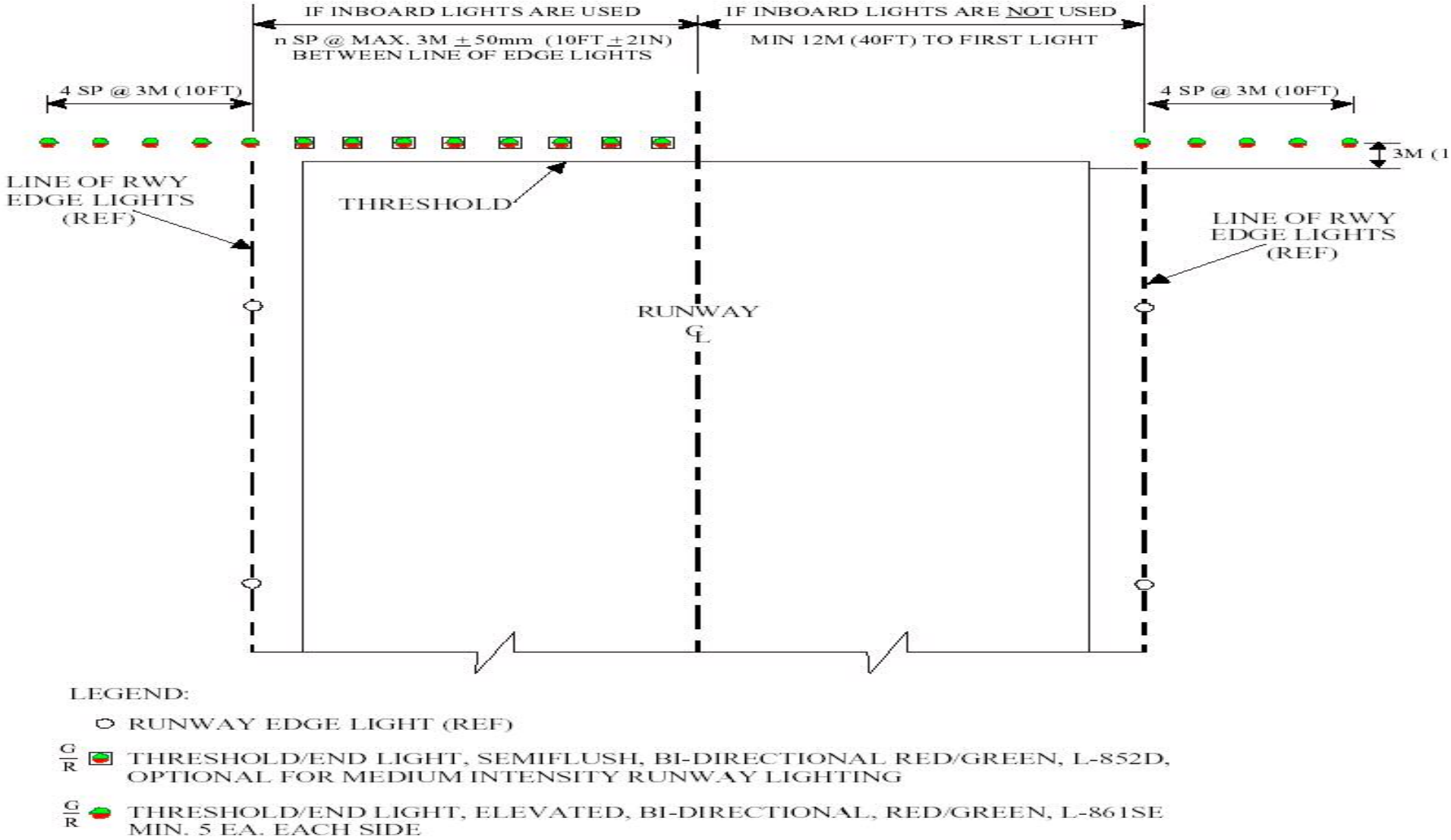
US Army Corps of Engineers®

UNIFIED FACILITIES CRITERIA (UFC)

DESIGN DRAWINGS FOR VISUAL AIR NAVIGATION FACILITIES

U.S. ARMY CORPS OF ENGINEERS
NAVAL FACILITIES ENGINEERING COMMAND
AIR FORCE CIVIL ENGINEER SUPPORT AGENCY

Figure 4.4. Threshold Light Configuration for Army.



4.4.2.1. Place a light where the line of threshold lights intersects the line of runway edge lights. Then place lights at 1.5 meters (5 feet) for a distance of 12 meters (40 feet) outboard of the runway edge light lines.
4.4.2.2. Place lights at uniform intervals between the lines of runway edge lights and along the line of the threshold lights. Space as near to 1.5 meters (5 feet) as possible and do not exceed 1.55 meters (5 feet 2 inches). The line of threshold lights may be gated to lessen the problem of tail hook bounce by eliminating

those lights in the center 21 meter (70 foot) portion of the threshold, but must be waived by the Major Command. Note that blank covers must be flush with the runway surface.

4.4.3. Medium Intensity Threshold Lights. Install threshold lights in a line perpendicular to the extended runway centerline outside the usable landing area a distance of not more than 3 meters (10 feet). The line of lights is symmetrical about the runway centerline and extends 12 meters (40 feet) outboard of the lines of runway edge lights. (See figure 4.4.) Determine the position of the lights as follows:

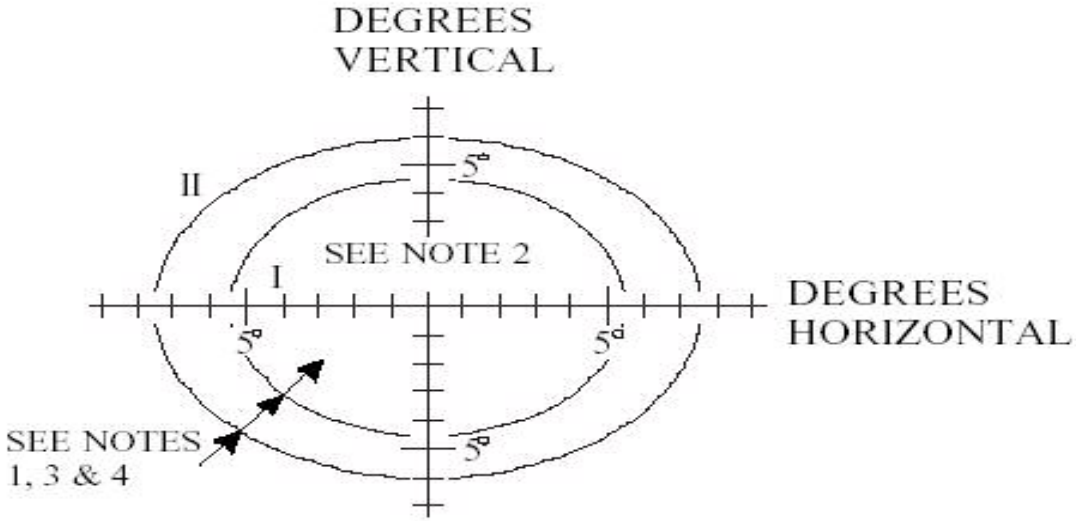
4.4.3.1. Place a light where the line of threshold lights intersects the line of runway edge lights. Next, place lights at 3 meters (10 feet) for a distance of 12 meters (40 feet) outboard of the runway edge light lines.

4.4.3.2. If inboard lights are used, place lights at uniform intervals between the lines of runway edge lights and along the line of the threshold lights. The interval must be a maximum of 3 meters (10 feet).

4.4.4. Photometric Requirements:

4.4.4.1. High Intensity Threshold Lights. Optimum aiming of lights depends on the design and output of the fixtures used in the system. Light fixtures may be designed to cover several applications and may have fixed patterns and aiming angles that differ from this document. Light aiming and patterns other than those given in the standard may be used if the resultant light pattern produces equivalent light intensities in the areas required by this standard. The lights must be uni-directional green aimed into the approach with intensities as shown in figure 4.5 when used with high intensity runway edge lights or approach lights. The light beams are aimed parallel with the runway centerline and angled upward at an angle of 4.5 degrees. High intensity threshold lights must operate at five intensity levels, together with the associated runway edge lights or approach lights when installed. High intensity runway edge lights will be used with high intensity threshold lights.

Figure 4.5. Threshold Light Photometric Requirements.



THRESHOLD LIGHTS, GREEN

	I=50%	II=10%
a	5.5°	7.5°
b	4.5°	6.0°

NOTES:

1. ALL CONTOURS ARE ELLIPSES CALCULATED BY EQUATION $\frac{X^2}{a^2} + \frac{Y^2}{b^2} = 1$
2. THE MINIMUM AVERAGE CANDELA IN GREEN LIGHT OF THE MAIN BEAM IS 3,200 CD FOR HIGH INTENSITY SYSTEMS AND 100 CD FOR MEDIUM INTENSITY SYSTEMS.
3. MAXIMUM INTENSITY SHOULD NOT EXCEED 1.5 TIMES THE MINIMUM AVERAGE CANDELA.
4. PORTIONS OF THE LIGHT BEAM CUT OFF BY THE MOUNTING SURFACE MAY BE DISREGARDED.

INCH-POUND

MIL-HDBK-1023/4
30 NOVEMBER 1998

DEPARTMENT OF DEFENSE
HANDBOOK

MAINTENANCE OF VISUAL AIR NAVIGATION FACILITIES

AMSC N/A

AREA FACR

Table A-3
High Intensity Approach Lighting Systems With Flashers (ALSF-1/ALSF-2)

Parameter	Standard	Tolerance / limit	
		Initial	Operating
1. Light units operational			
a. Steady burning	All	All	15% lamps out (random) - 2 lamps out; in 5-light bar - 1 light bar out
b. Flashing	All	All	1 unit out
2. Flashing rate	120 fpm	± 2 fpm	± 2 fpm
3. Input voltage	120 V or 240 V	± 3%	± 5%
4. Light unit alignment			
a. Vertical	Locally established	± 1 degree	± 2 degrees
b. Horizontal	Parallel to runway centerline	± 1 degree	± 2 degrees
5. Obstructions due to vegetation, etc.	No obstruction	Same as standard	Same as standard

A Good Maintenance Program -

- Needs properly trained Personnel familiar with preventative maintenance criteria, but -
- Always begins with a good design.
- And then a good installation.
- If a system is not specified and installed correctly -

The best preventative maintenance program in the world will not produce minimum requirements.

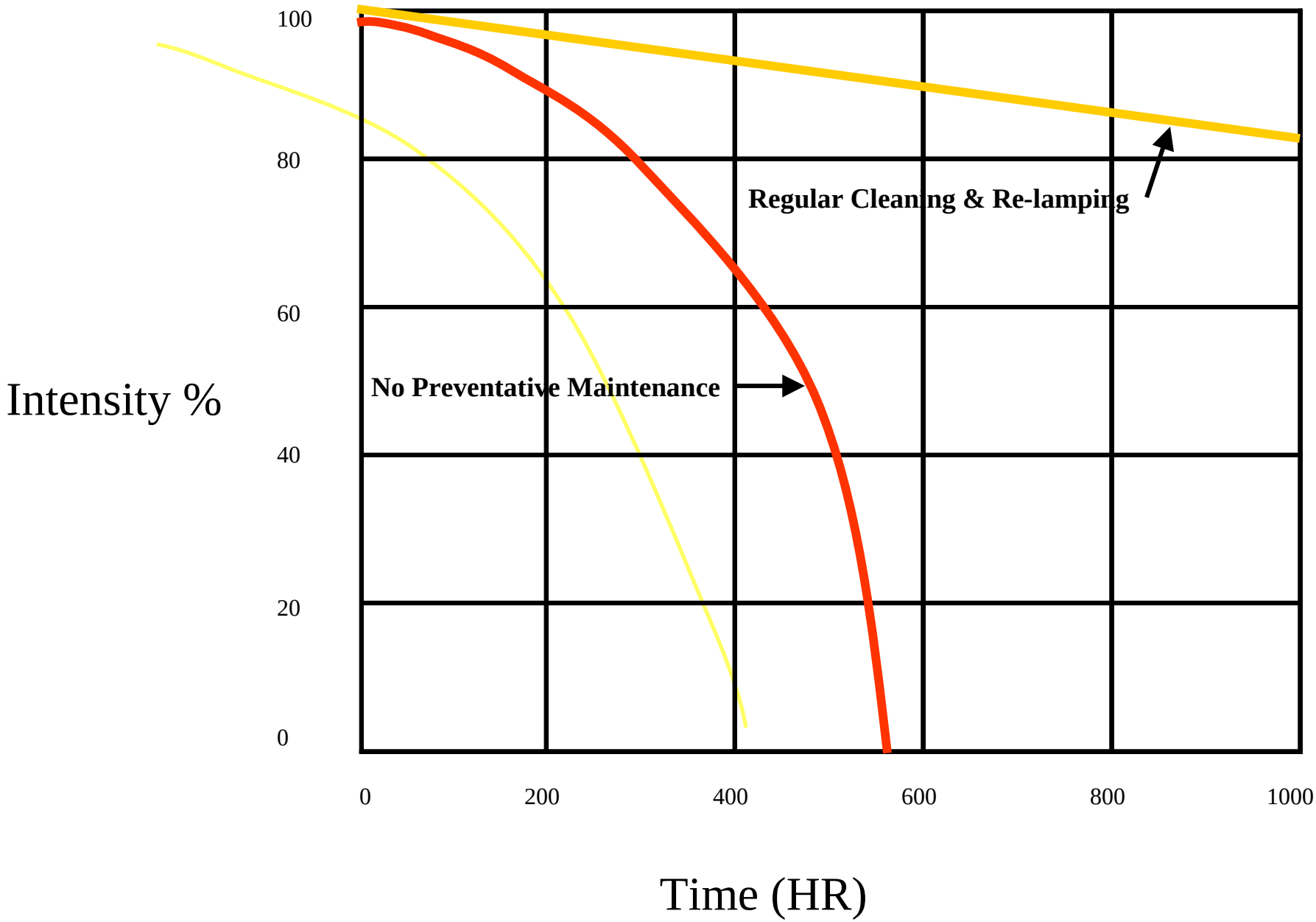
Airfield Lighting Deterioration

- **From the very moment airfield visual aids are turned on, all components of the system begin to deteriorate. *They are not "Fire & Forget"***
  - **Designed average life expectancy of visual aid systems, except lamps, is 20 years IF THEY ARE PROPERLY SPECIFIED, INSTALLED AND MAINTAINED.**
  - **Most newer lamps have an average life expectancy of 600 - 1000 hours, but the fixtures still require cleaning.**

Airfield Lighting Deterioration (Continued.)

- Lack of proper Specification, Installation and Inspection of airfield visual aid systems can INITIALLY reduce life expectancy by at least 50% and the photometric output even more.
  - Improperly sized regulators will produce high system voltages thus reducing life expectancy of cables and transformers radically.
  - Regulator amperage settings can either reduce light output below standard, or burn out lamps prematurely.
  - Improper aiming will initially render a fixture out of photometric requirements.
- Lack of proper preventative maintenance of airfield visual aids will reduce the intensity to a point where they are rapidly out of compliance with minimum output requirements set by the Military/FAA.
  - Even a thin film of jet fuel or de- icier on fixtures can reduce light output 50%
  - Lamps at the end of their life, although burning, will result in lower light output not meeting requirements.

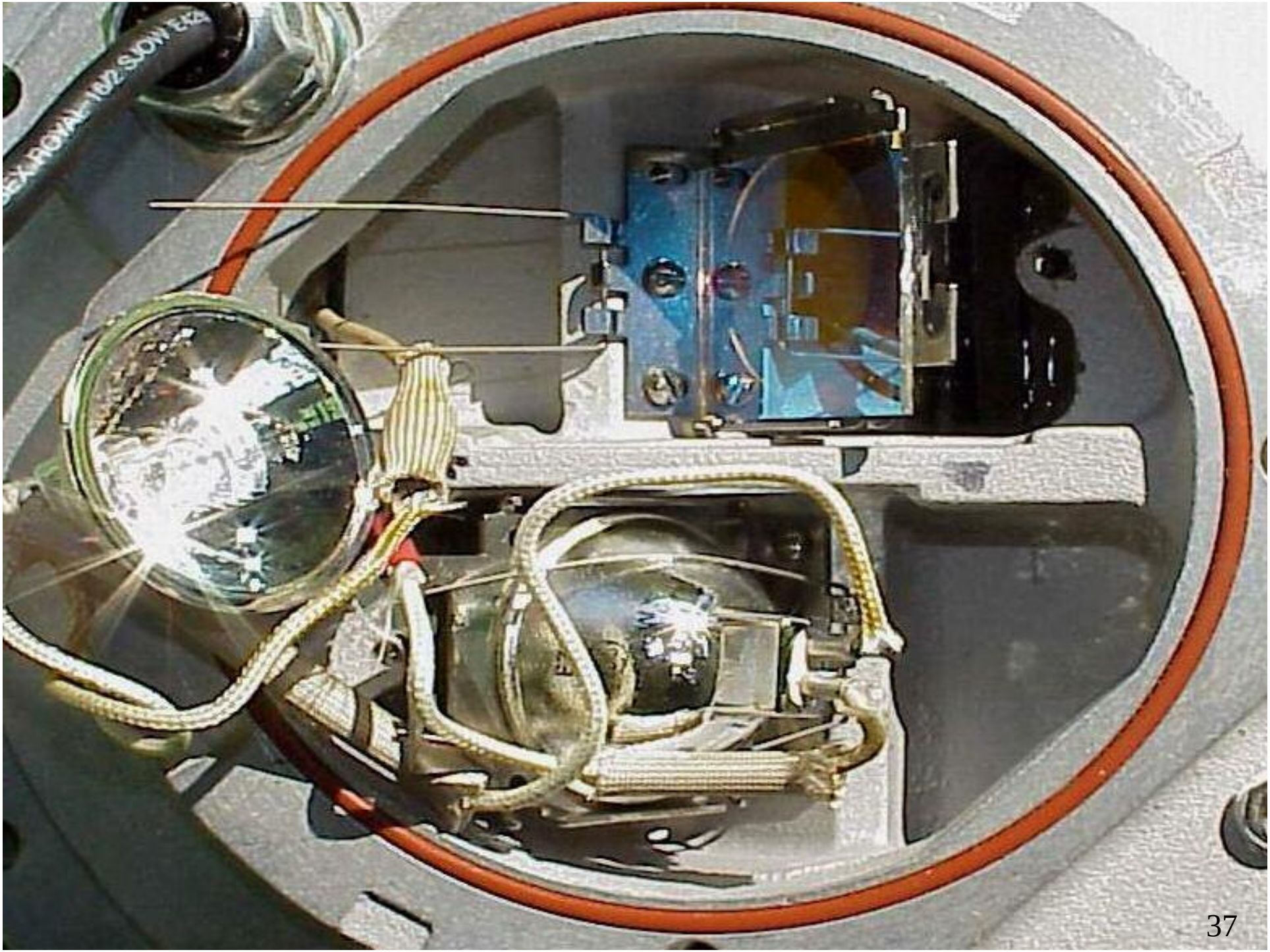
Airfield Lamp & Fixture Deterioration




Glass with thin oil film

Clean Glass

Thin Dirty Oil Film



Applicable FAA & Military Documents for Airfield Lighting Maintenance

- The "Bible" MIL-HDBK-1023/4 - Maintenance of Airfield Visual Aid Facilities
- AC 150/5345-53B & Appendix 3 - Airfield Lighting Equipment Certification Program
- AC 150/5345-46B - Specification for Runway & Taxiway Light Fixtures

MIL-HDBK-1023/4
Maintenance of Airfield Visual Aid Facilities

- This Document should be the "Bible" for your airfield lighting preventative maintenance program.
  - It gives specific preventative maintenance procedures.
  - It spells out specific tolerances.
  - It spells out specific safety procedures.
    - Items which should be included on a safety board to comply with OSHA.
    - It spells out specific "lock out tag out" safety procedures.
  - It lists which documents should be kept for reference.
  - It illustrates troubleshooting procedures.
  - It shows typical test equipment necessary for proper preventative maintenance of airfield lighting systems.

Table 14
Preventive Maintenance Inspection Schedule for
Precision Approach Path Indicator (PAPI) System

Maintenance Requirement	DAILY	WKLY	MTHLY	QTRLY	SMANY	ANNLY	UNSCH
1. Check lamps for operation.	X						
2. Check operation of controls.			X				
3. Check for damage by service vehicles or aircraft.			X				
4. Clean lamps and filters.			X				
5. Check mechanical parts for damage.			X				
6. Check lightning arresters.			X				
7. Check for water damage or insect infestation.			X				
8. Check for presence of rodents.			X				
9. Record output current and input voltage of adapter (if used).			X				
10. Check alignment and aiming of light boxes.			X				
11. Check leveling and operation of tilt switch.			X				
12. Check integrity of obstacle-free approach plane.				X			
13. Check insulation resistance of underground cables.					X		
14. Check resistance of grounding system.					X		

Table A-5
Precision Approach Path Indicator (PAPI)/
Chase Helicopter Approach Path Indicator (CHAPI) Systems

Parameter	Standard	Tolerance / limit	
		Initial	Operating
1. Lamps burning			
a. PAPI	All	All	Not more than one lamp out per box
b. CHAPI	All	All	
2. Vertical aiming [1/]			
a. Unit D (close to runway)	3° 30'	± 2 minutes	± 6 minutes
b. Unit C (2nd from runway)	3° 10'	± 2 minutes	± 6 minutes
c. Unit B	2° 50'	± 2 minutes	± 6 minutes
d. Unit A (farthest from runway)	2° 30'	± 2 minutes	± 6 minutes
3. Horizontal alignment	Parallel to runway centerline	± ½ degree	± ½ degree
4. Tilt switch	-¼ below to +½ degree above established light bar	Same as standard	Same as standard
5. Lamp current (current-regulated)	Rated current of lamps	Same as regulator currents for type of regulator used	
6. Lamp voltage (voltage-regulated)	Rated voltage of lamps	± 3%	± 5%
7. Obstructions due to vegetation, etc.	No obstruction	Same as standard	Same as standard

[1/] Unless a different standard is established locally, angles shown are for a 3 degree glide path.

AC 150/5345-53B & Appendix 3 - Airfield Lighting Equipment Certification Program

- Sets approved equipment list, but most importantly for maintenance defines specific lamp manufacturers and specific lamp numbers acceptable for maintenance replacement.

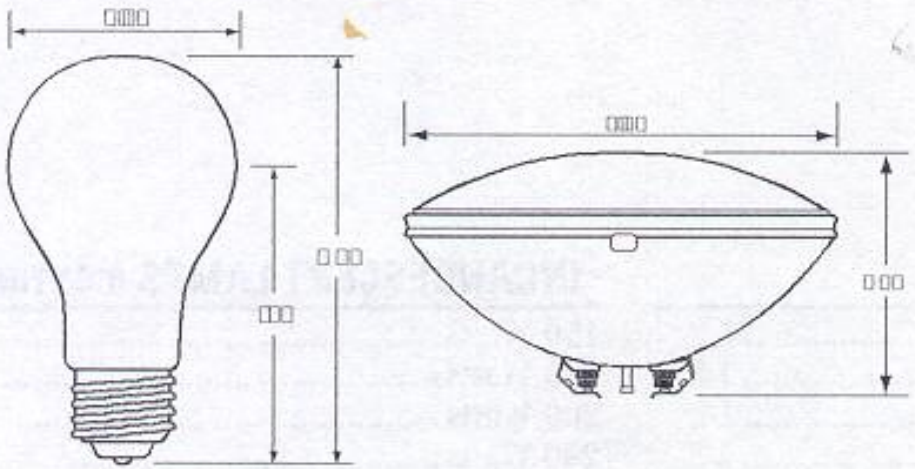
L-861--Lights, Runway & Taxiway Edge, Medium Intensity (AC 150/5345-46B)

Manufacturer	Type	
	L-861	216-X-X-X (10), 216Q-X-X-X (19)
	L-861E	216-X-X-X (11), 216Q-X-X-X (20)
	L-861T	216 X-X-X (10), 216Q-X-X-X (19)
	L-861SE	216SE-X-X-X-X (36)
	L-861	AS5023XXXXXX (31) (33) (11A) (10B)
	L-861E	AS5023XXXXXX (33) (11A)
	L-861T	AS5023XXXXXX (31) (33) (11A) (10B)
ALSTOM Power. Conversion Ltd	L-861	ZA216/1 (109)
	L-861T	ZA216/2 (108)
Crouse-Hinds ALP	L-861	40938-C-45-XX (17), 40938-CY-45-XX (17), 40939-C-45-XX (11A), 40939-CY-45-XX (11A), 40943-C-69-XX (04A), 40943-CY-69-XX (04A)
	L-861E	40938-RG-30-XX (18), 40938-RG-45-XX (17) 40939-RG-30-XX (10A), 40939-RG-45-XX (11A)
	L-861T	40938-B-30-XX (18), 40938-B-45-XX (17) 40939-B-30-XX (10A), 40939-B-45-XX (11A)
	L-861SE	40690-RG-115 (16), 40775-RG-115 (16)
Flight Light Inc.	L-861	10 Series (10C, 31)
	L-861E	10 Series (11C, 33)
	L-861T	10 Series (10C, 31)
	L-861SE	12 Series (36)
Honeywell Airport Systems	L-861	MI-XXX-X-XX-XX (11A, 33), MQ61C (series) (31), MQ61C4 (series) (31), MQ61C2 (series) (31), MQ61C5 (series) (31), MQ6142 (series) (31)
	L-861E	MI-XXX-X-XX-XX (11A, 33)
	L-861T	MI-XXX-X-XX-XX (10A, 31), MQ61T (series) (31, 33)
	L-861SE	MI-XXX-X-XX-XXS (36)
Manairco, Inc.	L-861	7100 (10C), 7100Q (31)
	L-861E	7250 (11A), 7250Q (33)
	L-861T	7400 (10C), 7400Q (31)
Multi-Electric Mfg, Inc.	L-861	6170-M-WW-XX (10A), 6170-M-WA-XX (11C), 6170-H-WW-XX (31)(33), 6170-H-WA-XX (31)(33) 6170-M-AA-XX (11C), 6170-H-AA-XX (31)(33)
	L-861E	6170-H-RG-XX (33), 6170-H-GO-XX (33), 6170-H-RR-XX (33), 6170-H-RB-XX (33), 6170-H-BB-XX (33)
	L-861T	6170-M-BB-XX (10A)(11B)(11C), 6170-H-BB-XX (31)
	L-861SE	6370SE-RG-XX (36), 6370SE-GO-XX (36)
Point Lighting Corporation	L-861	PEL-50000 (10C, 31)
	L-861E	PEL-50000-GR (11C, 33)
	L-861T	PEL-50000 (10C, 31)
	L-861SE	PEH-55100 (36)
Siemens Airfield Solutions, Inc.	L-861	44C1081-XXXX (10A, 11A, 14A, 31, 33, 92, 93, 95), 44C1752-XXXX (31, 45)
	L-861E	44C1081-XXXX (11A, 31, 33, 39)
	L-861T	44C1081-XXXX (10, 31, 39), 44C1752-XXXX (31 ,45)
	L-861SE	44C1485-1XXX(36), 44A2090-XXXX(36)
Youyang Airport Lighting	L-861T	YIT-A-1016/45-B (33)

LAMP DESCRIPTIONS

Lamp	Designation	Watts	Volts	Amps	Lamp Manufacturer
(1)	8301	40	120		Yorkville Industries
(2)	15T6	15	120		General Electric, Philips
(2A)	15T6	15	120		General Electric
(2B)	15T6	15	120		Philips
(3)	15T7C	15	120		Philips
(4)	69A21TS	69	120		General Electric, Sylvania, Philips
(4A)	69A21TS	69	120		General Electric
(4B)	69A21TS	69	120		Sylvania
(4C)	69A21TS	69	120		Philips
(5)	40C9½C/ST	40	120		Sylvania
(6)	25FC	25	120		General Electric, Sylvania
(6A)	25FC	25	120		General Electric
(6B)	25FC	25	120		Sylvania
(7)	15A15/CL	15	120		Sylvania
(8)	25A19/GR/CL	25	120		Sylvania
(9)	40A21/GR/CL	40	120		Sylvania
(10)	6.6A/T10/1P	30		6.6	General Electric, Sylvania, Philips
(10A)	6.6A/T10/1P	30		6.6	General Electric
(10B)	6.6A/T10/1P	30		6.6	Sylvania
(10C)	6.6A/T10/1P	30		6.6	Philips
(11)	6.6A/T10/P	45		6.6	General Electric, Sylvania, Philips
(11A)	6.6A/T10/P	45		6.6	General Electric
(11B)	6.6A/T10/P	45		6.6	Sylvania
(11C)	6.6A/T10/P	45		6.6	Philips
(12)	40A/TS	40	120		General Electric, Sylvania, Philips
(12A)	40A/TS	40	120		General Electric
(12B)	40A/TS	40	120		Sylvania
(12C)	40A/TS	40	120		Philips
(13)	25A/CL	25	120		General Electric, Sylvania
(13A)	25A/CL	25	120		General Electric
(13B)	25A/CL	25	120		Sylvania
(14)	40T10P	40	120		General Electric, Sylvania
(14A)	40T10P	40	120		General Electric
(14B)	40T10P	40	120		Sylvania
(15)	6.6AQ CL/DCR	200		6.6	Sylvania
(16)	20058	115		6.6	Crouse-Hinds
(17)	40732	45		6.6	Crouse-Hinds
(18)	40737	30		6.6	Crouse-Hinds
(19)	HG132PPF	30		6.6	Sylvania
(20)	HG112PPF	45		6.6	Sylvania
(21)	EWR	150		6.6	General Electric
(22)	6.6A/T14/2P	204		6.6	General Electric, Sylvania, Philips
(22A)	6.6A/T14/2P	204		6.6	General Electric
(22B)	6.6A/T14/2P	204		6.6	Sylvania
(22C)	6.6A/T14/2P	204		6.6	Philips
(24)	25T8	25	120		General Electric
(26)	6.6ATSQ/CL2	115		6.6	Sylvania
(29)	48A0071	200		6.6	Siemens Airfield Solutions, Inc.
(30)	100A21/TS	100	120		General Electric
(31)	EXL	30		6.6	General Electric
(32A)	116A21/TS	116	120		General Electric
(32B)	116A21/TS	116	120		Philips
(33)	EXM	45		6.6	General Electric

BULB IDENTIFICATION



DIA: Diameter of bulb at widest point.

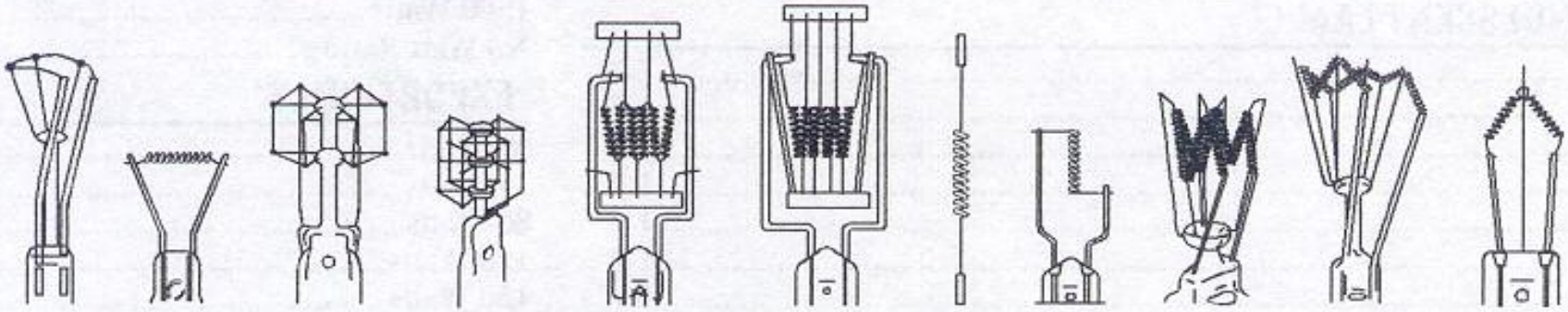
MOL: Maximum Overall Length including base or pins.

LCL: Distance between the center of the arc tube and the Light Center Length reference plane.

Note: Lamp drawings are not drawn to scale. Be sure to check size and dimension information when identifying each lamp.

To convert inches to millimeters, multiply the dimension (in inches) by 25.4 (i.e. 1.5" x 25.4 = 38.1 mm).

FILAMENT IDENTIFICATION



C-9 | C-6 CC-6 | C-17 | C-22 | C-13 | C-13D | CC-8 | C-8 CC-8 | C-5 | C-7A | C-2V CC-2V

AC 150/5345-46B - Specification for Runway & Taxiway Light Fixtures

- Defines Coverage and Candelas for each specific light fixture. Gives required minimum beam width, height and intensity for FAA compliance.

- This is important should you be involved in a lawsuit and have to defend yourselves because of an “on-site photometric test”

Table 1. Photometric requirements for in-pavement lights.

Type	Minimum beam coverage (degrees) (a)				Intensity (candelas) (b)				
	Main beam (c)		10 percent (d)						
	H	V	H	V	White	Yellow	Green	Red	Blue
L-850A	±5	0.2 to 9	±7	-4 to 13	5000			750	
L-850B	-1 to 9	2 to 9	-3 to 11	-0.5 to 11.5	5000				
L-850C	-2 to 9	0.2 to 7	-4 to 11	-2.5 to 9.5	10000	5000		1500	75
L-850D	-2 to 9	1 to 10					3300		
	±6	0.2 to 4.7	±7.5	-2.5 to 7.5				2500	
L-850E	±6	1 to 9					5000		
L-850F	±5	0.2 to 9	±7	-4 to 13	5000(e)				
L-852A	±10	1 to 4	±16	0.5 to 10		20	20		
L-852B	±30	1 to 4	±30	0.5 to 10		20	20		
L-852C	±3.5	1 to 8	±4.5	0 to 13		200	200		
L-852D	±30	1 to 10	±30	0 to 15		100	100		
L-852E	360	1 to 8				50(f)			
L-852F	360	1 to 10				200(f)			
L-852G	±24	1 to 10	±30	0.5 to 13		1000(g)			
L-852S	±24	1 to 10	±30	0.5 to 13				300(g)	
L-852T	360	1 to 6							2 (h)

(a) For runway fixtures, beam coverage given is for the extremities of an ellipse. For taxiway fixtures, beam coverage is for the extremities of a rectangle with the exception of L-852G for which corners may be rounded on a 5 degree radius.

(b) Values given represent minimum average intensity except for L-850E, where minimum intensity is given. See ¶4.3 for method of calculating average beam intensities.

(c) In addition to the average intensity requirements, all points within the main beam must be at least fifty percent of the specified average intensity.

(d) The intensity in this isocandela curve must be at least 10 percent of the specified minimum average intensity. The main beam and 10 percent curves are concentric; that is, the main beam curve lies exactly in the center of the 10 percent curve. For in-pavement lights, any part of the curve that falls below grade may be disregarded.

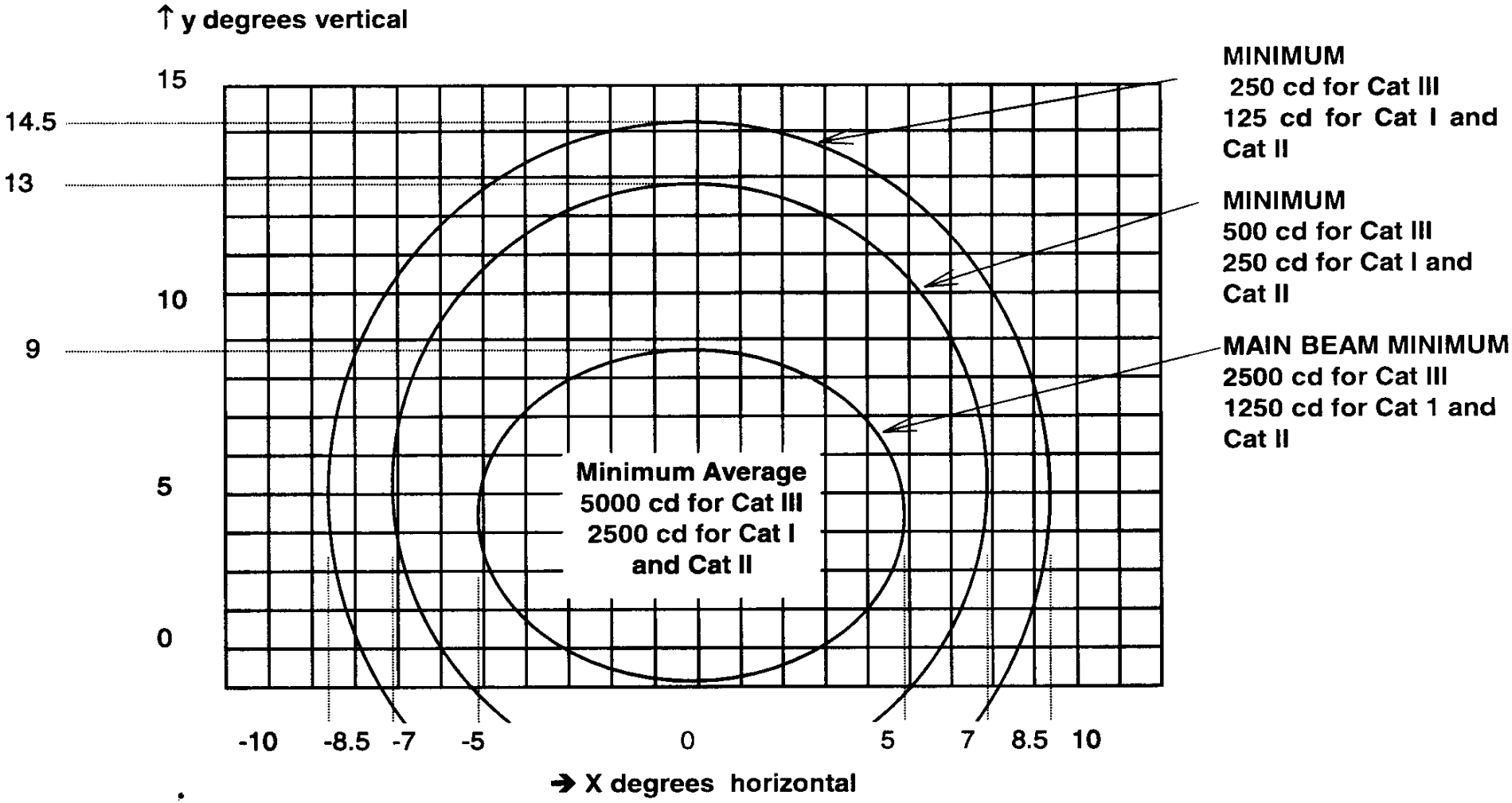
(e) In the case of L-850F, each lamp shall independently meet the photometrics.

(f) Twenty-five percent reduction of candela intensity is allowed at structural ribs.

(g) L-852S shall be traffic signal red and L-852G shall be traffic signal yellow in accordance with the ITE Standard for Vehicle Traffic Control Signal Heads.

(h) L-852T coverage is 2 candelas from 0 to 6 degrees vertically and 0.2 candela at all other vertical angles. Use of this light should be restricted to where elevated lights may be damaged by jet blast or where they interfere with aircraft operations. Manufacturers shall advise potential users of this fact before providing these lights or tag them to that effect.

Diagram 7.1 Isocandela Diagram for Runway Centerline Light With 15m Longitudinal Spacing (White Light)



Notes:

1 Curves calculated on formula $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

a	5.0	7.0	8.5
b	4.5	8.5	10

2 For red light multiply values by 0.15

Table 2. Photometric requirements for directional elevated lights.

Type		Minimum beam coverage (degrees)				Intensity (candelas) (b)				
		Main beam		10 percent (e)						
		H	V	H	V	White	Yellow	Green	Red	Blue
L-804	(f)	±8	±8	±25	±25		3000(g)			
L-861E	(d)	±1.5	3.5 to 5.5					300		
	(d)	±3	1.5 to 7.5					180		
	(d)	±5	0 to 7					90	10	2
L-861SE	(a)	±15	2 to 10					600		
	(a)	±5	0 to 7						20	
L-862	(a) (c)	-2 to 9	0 to 7	-4 to 11	-2.5 to 9.5	10,000	5,000		2000	200
L-862E	(a)	±6	0.2 to 4.7	±7.5	-2.5 to 7.5				2500	
	(a)	-2 to 9	1 to 10					3,200		
L-862S	(d)	±7	±4	±14	±8				2000(g)	

(a) Beam coverage is given for the extremities of an ellipse.

(b) Values given represent minimum average intensity. See paragraph 4.3.

(c) Minimum of 50 candelas required omnidirectionally for all vertical angles to 15 degrees.

(d) Beam coverage is given for the extremities of a rectangle.

(e) See note (c) and (d) of Table 1.

(f) Beam coverage is given for the extremities of a circle, except that the area below -10° vertical is ignored. Additionally, the intensity shall be at least 1,000 cd at every point within a circle of ±15°.

(g) Red for L-862S shall be traffic signal red, and yellow for L-804 shall be traffic signal yellow in accordance with the Institute of Transportation Engineers Standard for Vehicle Traffic Control Signal Heads.

And if I don't have your attention yet ------

Poorly trained people doing this work do not understand their personal liability.

- Because of the **"I"** - **Personal Safety!!! And Safety of Others due to my actions!!!**
- Because of the **"I"** - **Personal Liability!!!**
- **In some Jurisdictions EVEN Criminal Liability!!!!!**

What other reasons are there for a GOOD Training Program for your Airfield Lighting Personnel?

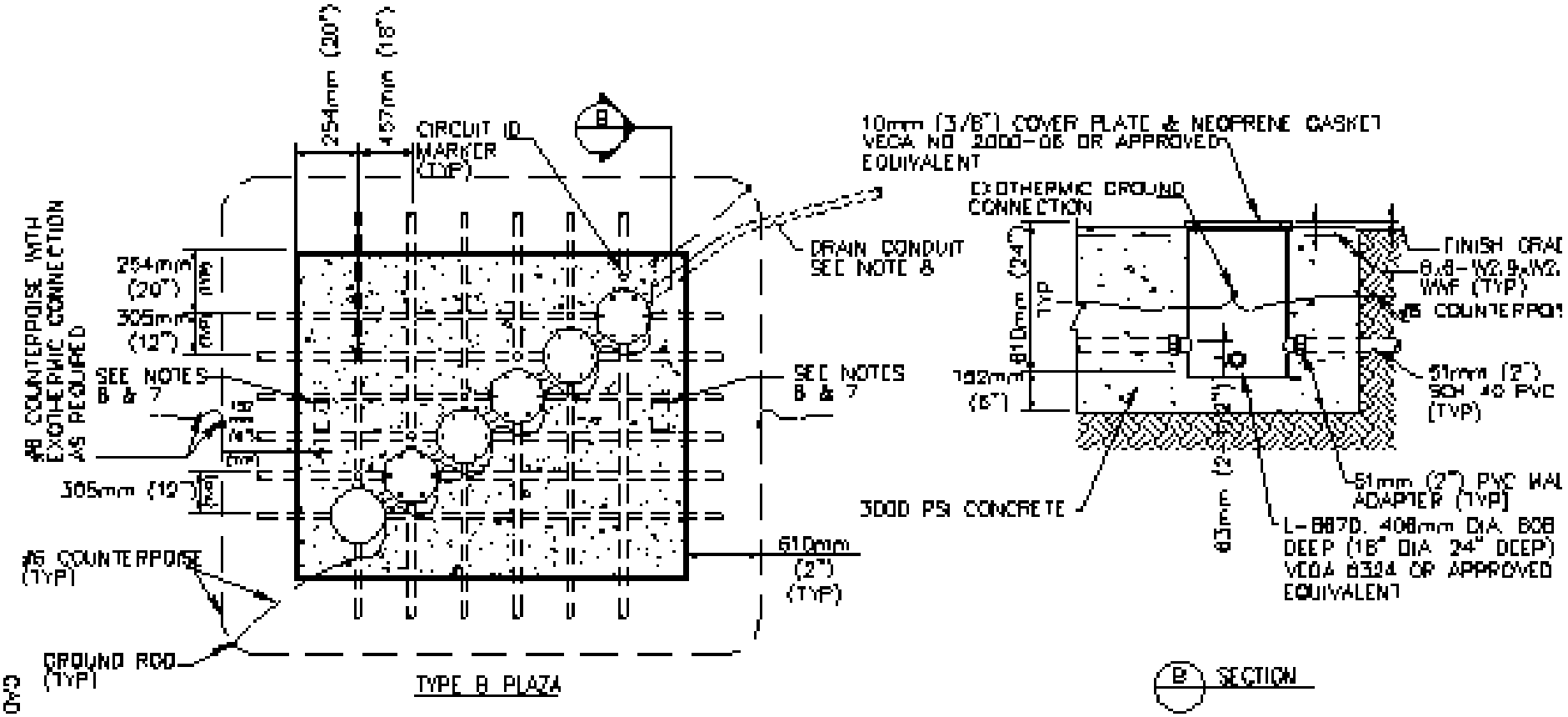
- ***Safety***

  Safety for flight crews & passengers.
  Safety for installation & maintenance personnel.
  Assures your Airfield meets all standards for operation.

- ***Liability***

  As a Defense - to prove you have identified all risks and have taken and documented steps to prevent or lesson airfield lighting risks.


POSTER



JUNCTION CAN PLAZA, TYPE B (AIR FORCE ONLY)

NOT TO SCALE

NOTES:

1. NUMBER OF JUNCTION CANS AND CONDUIT CONFIGURATIONS VARY. SEE LAYOUT PLAN SHEETS FOR ORIENTATION.
2. CONDUITS WHICH ARE NOT USED IN THE PROJECT SHALL BE CAPPED 304mm (12") OUTSIDE OF PLAZA CONCRETE.
3. ORIENT PLAZA AS SHOWN ON LAYOUT PLAN SHEETS.
4. CONTRACTOR SHALL PROVIDE A 51mm (2") DIA DOMED BRONZE MARKER AT EACH JUNCTION CAN AS SHOWN. MARKER SHALL BE STAMPED WITH CIRCUIT IDENTIFICATION AS SHOWN ON LAYOUT PLAN SHEETS.
5. INSTALL GROUND RODS AND GROUND LOOP AT ALL JUNCTION CAN PLAZAS AS SHOWN. TWO GROUND RODS PER PLAZA LOCATED AT OPPOSITE CORNERS SHALL BE PROVIDED. COUNTERPOISE SHALL BE LOCATED NOMINALLY 304mm (12") BELOW EXISTING GRADE.
6. CONTRACTOR SHALL LABEL 2 ENDS OF EACH JUNCTION CAN PLAZA (JCP) BY IMPRESSING THE JCP IDENTIFICATION NUMBER INTO THE CONCRETE FOUNDATION DURING PLACEMENT. LETTERS AND NUMBERS SHALL BE 102mm (4") IN HEIGHT, PROPORTIONAL IN WIDTH, AND HAVE A STROKE WIDTH OF 13mm (1/2") AND 6mm (1/4") DEPTH.
7. SEE LAYOUT PLAN SHEETS FOR JCP IDENTIFICATION NUMBERS.
8. DRAIN CONDUITS SHALL BE PROVIDED WHERE SHOWN ON THE LIGHTING AND SIGNAGE LAYOUT SHEETS. SEE FIGURE 7B FOR CONNECTION TO JUNCTION CANS.

REFERENCE FIGURE: 7S
CAD FILE: JUNCTION CAN PLAZA, TYPE B.DWG
SEE NOTES TO DESIGNER T31 FILES: JUNCTION CAN PLAZA, TYPE B-NTOOOC

More reasons for a GOOD Training Program for your Airfield Lighting Personnel.

- *A GOOD Training Program is a Valuable Risk Management Tool*
  - *Pays for itself by Reducing risks involved with airfield lighting*
  - *Helps justify your existence by identifying compliance requirements.*
  - *Ensures your personnel are competent.*
  - *Aids in budget preparation by identifying necessary expenditures.*
  - *Aids in scheduling of resources by identifying required tasks.*
  - *Aids in scheduling new construction by identifying substandard components.*
  - *Insures new systems are designed correctly.*
  - *Insures new construction is installed correctly.*
  - *Insures systems remain in continuing compliance.*

Available Options

- **Bury your head in the sand and say disaster won't strike here.**
  - Trust to fate and accept eventuality.
  - Continue battling lack of funds & personnel.
- **Professionally Train all Personnel.**
  - Plan for eventuality by prevention and documentation.
  - Assure Regulatory Compliance.
  - Provide valid documentation for funding & personnel.
  - Make Your airfield **SAFER** for users and employees.
- **It costs more to adopt a Training Program -**
- **But not as much as a bad installation.**
- **But not as much as One accident would cost.**
- **Can your Airfield Afford Not to?**

Recommendation

- Think like a pilot - The 5 C's
  - Candelas
  - Coverage
  - Configuration
  - Color
  - Consistency
- Adopt a Professional Active Design & Maintenance Training Program.
  - Don't rely on training on-the-job.

Vision Statement

- **I want to see a day when Standardized Training and *Certification* is required Worldwide for those who design, install, maintain & Manage Airfield Lighting Systems.**
  - **Training for the 5 C's**
  - **Training for Safety**
  - **Training for Risk Management**
  - **Training for Design**
  - **Training for Construction**
  - **Training for Maintenance**
  - **Training for Management**

Thanks for your attention!

- **Any Questions?**

Internationally Recognized Professional Airfield Lighting Training for Military, Commercial and General Aviation airfields.

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